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The Multicenter Osteoarthritis Study (MOST): Opportunities for Rehabilitation Research

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Abstract

The Multicenter Osteoarthritis Study (MOST) is a longitudinal observational study of the effects of biomechanical, bone and joint structural, and nutritional factors on the incidence and progression of knee symptoms and radiographic and symptomatic knee osteoarthritis (OA). It is the first large-scale epidemiologic study to focus on symptomatic knee OA in a community-based sample of adultswith or at high risk for knee OA, based on thepresence of knee symptoms, history of knee injury or surgery or being overweight. Beginning in 2003, 3026 individuals (60.1% women) age 50-79 years were enrolled. Examinations at baseline, and 15, 30, 60, 72 and 84 months later included assessment of risk factors, disease characteristics, body functions and structure, and measures of physical activity and participation. The wealth of data from this longitudinal cohort of community-dwelling older adults affords valuable opportunities for rehabilitation researchers.

Introduction to the MOST Study

Osteoarthritis (OA) is the most common form of arthritis and the primary cause of disability in older adults. The knee is the weight-bearing joint most commonly affected by OA, and 16% of adults over age 45 years will develop symptomatic knee OA at some point in their lives.[1] For obese adults, the risk increases to two in three, accounting for many of the 27 million adults suffering from knee OA in the USand contributing annually to an estimated $185.5 billion in excess health care costs.[2] Furthermore, there is a clear upward trend in the prevalence and estimated costs of knee OA. Unlike most chronic diseases, little is known about the development of OA or its progression and, currently, there are fewpreventive

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How to Obtain Data: Data from most of the measurements made in the first cycle of examinations, as well as detailed descriptions of the measurements, are available at the MOST Online public data sharing website (http://most.ucsf.edu/). Details about obtaining access and potential collaboration with MOST investigators in analyzing the data are available on the website. Data from additional measurements will be released in the future.

strategies to offer persons at risk for the disease. Although determining means of prevention is of paramount importance, there also is a need to minimize disablement in those with existing knee OA. The Multicenter Osteoarthritis Study (MOST) is a longitudinal, prospective observational study funded by the National Institute on Aging. The overall aims of MOST are to identify novel and modifiable risk factors for radiographic and symptomatic knee OA and to determine whether risk factors for new disease differ from those for worsening disease. MOST consists of a community-sampled cohort of men and women either with preexisting knee OA or at high risk, as indicated by being overweight, having current knee symptoms or a history of knee injury or surgery. There are two clinical centers, a data-coordinating center, and an analysis center. At baseline, MOST recruited 3026 men and women aged 50 to 79 from the general populationsurroundingIowaCity, Iowa and Birmingham, Alabama. To date, MOST has completed baseline, 15-, 30-, 60-, 72- and 84-month follow-up visits. The baseline visit included screening of risk factors and disease characteristics to identify knee symptoms that did not emanate from the knee joint. At each visit, clinical assessments (e.g. examinations of tender points; hand, hip and knee joints; and physical performance) and imaging (dual energy X-ray absorptiometry (DXA), radiographs, and magnetic resonance imaging (MRI)) were completed.

MOST is the first large-scale observational study to focus on disablement in persons with or at elevated risk for knee OA. One key area in which MOST adds value is through the ability to identify modifiable risk factors for disease and associated impairments, activity limitations, participation restrictions, and quality of life reductions. Major findings include the powerful predictive value of enlarging MRI-visualized bone marrow lesions and synovitis on the development of new knee pain, suggesting that pain in knee OA often emanates from bone as well as soft tissue. Other important findings relate to the predictive value of bone mineral density, obesity, impaired quadriceps strength, and meniscal tears in modifying risk for knee OA. However, there is a wealth of data that has been collected regarding impairments (e.g. pain, range of motion), activity limitations (e.g. gait and chair, and community mobility), participation and quality of life restrictions that have not been fully utilized. Interpretation of these data has potential to guide rehabilitation interventions and inform decisions about how best to directresources to those at greatest risk of disability. In addition, MOST offers a unique opportunity to study knee arthroplastysurgical and rehabilitation outcomes prospectively in a community-based (rather than clinic-based) sample. The purpose of this report is to familiarize rehabilitation providers with the collaborative research opportunities that exist usingthis large cohort.

Study Aims

The MOST study introduced six new approaches into the epidemiologic study of knee OA: 1) a focus on the development of symptomatic, rather than radiographic disease (enhancing health relevance), 2) a comprehensive evaluation of risk factors including modifiable ones, 3) a focus on those who would most benefit from prevention, 4) the incorporation of more comprehensive and reproducible imaging than has been used previously, 5) the incorporation of reliable longitudinal measures of pain, self-reported functional status and physical performance and 6) the development of novel and less biased methodology to study disease progression.

The specific aims of the initial MOST study period, which consisted of baseline to30-monthfollow-upwere:

1. To longitudinally evaluate the effects of three groups of factors on risk for radiographic, symptomatic, and worsening knee OA: biomechanical factors (including physical activity-related and joint loading factors), bone and joint structural factors (including those assessed by DXA and MRI), and nutritional

factors that affect the occurrence and progression of knee symptoms (e.g. pain and stiffness)

2. To determine whether factors that affect incident disease differ from factors affecting progression.

3. To collect plasma, serum, DNA, and urine samples to create a specimen bank for future biochemical and genetic studies of biomarkers.

In a second funded cycle of examinations, the study focused on advancing understanding of the effects of the following factors on risk for knee OA and associated disablement: 1) spatiotemporal parameters of gait and foot pronation/supination, 2) muscle function and activation pattern, 3) knee instability symptoms and fear of falling, and 4) altered pain perception. In addition, the extended follow-up will support studies of the trajectory of impairments of structure and function, as well as activity limitations and participation restriction.

Profile of the Cohort

Locations and Sampling

The MOST study sought to recruit a community-based sample of men and women aged 50 to 79, drawn from the general population but selected so as to be likely to either have preexisting knee OA (one-third) or be at high risk for knee OA (two-thirds), while maintaining a distribution of age and sex in proportion to the U.S. population (Table 1). As the primary goal of the study has been to evaluate factors that affect the course of knee OA, the cohort was sampled with attention to recruiting adults with risk factors, such as biomechanical abnormalities of the knee, and evaluated factors such as muscle weakness, dietary deficiencies, physical activities that stress the knee, high bone mineral density, and knee abnormalities that can be visualized by MRI.

The University of Alabama at Birmingham (UAB) and The University of Iowa (UI) are the clinical centers for participant recruitment and measurements. Each center attempted to recruit ethnic minorities according to their representation in the recruitment area populations. The UAB site contributed a higher proportion of African Americans due to the differences in the racial make-up of the communities surrounding UAB and UI. The University of California, SanFrancisco (UCSF) is the Coordinating Center, Data Management Center, Quality Control Center, and MRI Reading Center. Boston University (BU) is the Radiograph Reading Center and Data Analysis Center.

Participants were seen at one of the two clinical centers for baseline examinations and the administration of questionnaires. At 15-month follow-up, all participants were contacted for a telephone interview. Participants who reported new frequent knee symptoms during the telephone interview, as well as two randomly selected control participants per case knee, were invited to return to the clinic for knee radiographs and MRI. All surviving participants were invited to a follow-up telephone interview and clinic examination at 30 months. Surviving participants were also invited to participate in the second cycle of telephone interviews (60, 72 and 84 months after baseline) and clinic examinations (60 and 84 months). Baseline visits took place between April, 2003 and April, 2005. The 15-month phone contacts (with an examination, knee x-ray, and MRI for 635 participants with new knee pain and matched controls) took place between February, 2005 and May, 2006 and the 30-month visit in all subjects occurred between January, 2006 and November, 2007. Date ranges for all visits are detailed in Table 2.

Recruitment and Retention

The primary recruitment strategy was mass mailings of letters and study brochures, supplemented by media and community outreach campaigns. Age-eligible people were identified through a variety of sources: HMO membership databases, voter registration tapes, commercial list brokers, and other sources. Both clinical centers identified organizations, agencies, group residences, and additional sources that had older adults. A total of 1517 participants were enrolled at UAB and 1509 at UI. Of the 3026 participants, 2713 and 2330 participants returned for follow-up clinic visits at the 30- and 60-month visits respectively. Follow-up rates were 91% and 79% of the living participants at these visits (99% and 94% participated in telephone interviews respectively). A total of2638of the living participants were invited and 2231 participants completed the 84-month follow-up clinic visit. A total of 143 of the original 3026 participants are deceased (4%). Retention rates are detailed in Table 3.

MOST has been conducted in accordance with U.S. Department of Health & Human Services Protection of Human Subjects regulations (45 CFR part 46) and the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) of 1996. Research data and image sets are de-identified in accordance with regulation 45 CFR 164.514(e) relating to limited datasets. Study participants were recruited under local institutional review board (IRB) approval and underwent an informed consent process, culminating in signing an IRB-approved consent document prior to enrollment.

Exclusion criteria

Potential volunteers were excluded if, at baseline, they had bilateral knee replacements, were not competent to provide informed consent, planned to move out of the area prior to follow-up, had a life-threatening illness that made it unlikely that they would survive to follow-up, or had been diagnosed with rheumatoid or other inflammatory arthritis.

Measures

I. First cycle of clinic examinations and phone interviews (baseline, 15 and 30 months)

Knee Imaging—At baseline, knee radiographs were obtained in all participants. Knee imaging was obtained at follow-up visits in eligible participants. Radiographs included bilateral, standing fixed-flexed posterior-anterior view of the tibiofemoral joint as well as weight-bearing, lateral view of the knees that provide information on the patellofemoral joint as well as the tibiofemoral joint space. X-rays are graded from 0 to 4 according to the Kellgren-Lawrence scale[3]with an additional score of 3.5 meaning grade 4 on the PA view but with residual joint space on the lateral film. Joint space narrowing was scored from 0 to 3 according to the OARSI Radiographic Atlas, allowing for half grade increments. Knee alignment has been determined from full lower limb x-rays. Knee MRI was completed in participants without contraindications and who did not exceed size limitations of the ONI OrthOne extremity MRI scanner (83% of the cohort). At the 15-month follow-up MR-imaging was performed in a subset of the study population – those who reported knee symptoms at the 15-month follow-up but not at baseline and those who didnot report frequent symptoms at baseline or follow-up. Semi-quantitative MRI readings were obtained for participants selected for several MRI sub-studies using the Whole Organ MRI Scoring system (WORMS).[4]

Biospecimens—Baseline blood and urine specimens were obtained and archived for 97.7% and 99.6% of the cohort, respectively. Blood and urine specimens were collected at 30 months in 42% of the cohort.

Pain and Proprioception—Physical examinations of joints that were conducted at enrollment, 15 and 30 months included assessments of tenderness at the greater trochanters, iliotibial band at the lateral femoral condyle, anserine bursa, tibiofemoral joint line, lateral and medial patella, medial knee fat pad, trapezius and lateral epicondyle; as well as hip internal rotation (pain and range of motion). Proprioceptive acuity was assessed through measurement of non-weight bearing joint reposition sense.[5]

Physical Performance and Body Composition—Objective measures of physical performance, including repeated chair stands, 20-meter walk (at usual walking pace), and lower limb isokinetic strength tasks were completed at baseline and 30 months.[6] Body composition was assessed with whole body dual X-ray absorptiometry (DXA) at baseline and 30 months.[7]

Self-Reported Health—Patient-reported OA-related outcomes included knee and hip pain and function (Western Ontario and McMaster Universities Osteoarthritis Index - WOMAC), disability (Late-Life Function and Disability Index-LLFDI) and function in sports and leisure activities (Knee Injury and Osteoarthrits Outcome Score - KOOS). Other self-reported health outcomes measures included mental health and physical function (SF-12) comorbid conditions (Charlson Comorbidity Index) and depressive symptoms (Center for Epidemiologic Studies Depression Scale (CES-D). Subjective measures of physical activity were obtained using the Physical Activity Scale for the elderly (PASE New England Research Institute, Medway, MA) instrument at baseline and 30 months. Data that are currently publicly available are summarized in Table 2.

II. Second cycle of clinic examinations and phone interviews (60, 72 and 84 months)

Most of the examination and questionnaire measures obtained at baseline and 30 months (see above) were repeated in the second cycle of examinations. In addition, several biomechanical and sensory assessments were introduced in the clinic examination at 60 months. None of these measures have previously been assessed in large epidemiological cohort studies of OA, yet each may have an important and modifiable role in determining the risk for knee OA development as well as the clinical, functional and disability outcomes associated with this disease.

Gait—Foot loading and gait parameters wereassessed using an Emed-X digital pedobarograph (Novel Electronics, Inc., St. Paul, MN) and a GAITRite walkway (GAITRite walkway (MAP/CIR Systems, Inc., Havertown, PA) respectively. Participants completed 4 trials each of usual and fast paced walking for collection of gait parameters, and 5 trials of usual paced walking for collection of plantar pressure in each foot.

Physical Activity—Both subjective and objective measures of physical activity were assessed in MOST. The subjective data were obtained using the Physical Activity Scale for the Elderly (PASE: New England Research Institute, Watertown, MA) in participants who did not complete accelerometry at 60 months, and in those eligible to wear the accelerometer but who did not do so at 84 months. In consenting participants, physical activity levels outside of the clinic environment was objectively measured over a 7-day period using an ankle-worn StepWatch 3 Activity Monitor (Orthocare Innovations, LLC, Oklahoma City, OK).[8]

Sensory Modalities—Vibratory sensory deficits were quantified through use of a biothesiometer (Bio-Medical Instrument Co., Newbury, OH), a device similar to a handheld tuning fork and allows for reliable and quantitative measurement of vibratory perception.[9] Peripheral sensory deficits have previously been reported in OA of the knee. Development

of effective approaches to the prevention or management of pain requires an understanding of the mechanisms that underlie abnormal pain sensitivity. To date, studies examining the role of abnormal pain sensitivity in OA have been limited to small cross-sectional studies. MOST provides the opportunity to assess pain sensitivity in a large longitudinal cohort. Abnormal pain perception was evaluated using standardized methods for assessing pain—temporal summation and pressure and touch sensitivity. In addition, coping strategies, pain catastrophizing and sleep quality were assessed by questionnaires.

Muscle strength and co-activation—Peak knee extensor and flexor isokinetic torque was defined as the maximal torque produced at 60°/sec for each lower limb over 4 trials. Co-activation levels of the medial and lateral quadriceps and hamstring muscles were measured by surface electromyography for each of four repetitions during isokinetic strength testing and were normalized to the maximal level of agonist activation.

Principal Rehabilitation Findings to Date

Frequently, knee pain is provoked by weight bearing activity. This underscores both the strong potential for knee OA to interfere with healthy physical activity, and the likelihood that load distribution at the knee can affect OA risk. At the baseline examination, strength of the knee extensors and flexors as well as physical activity were particular measures of interest, as the surrounding musculature has been reported to be the primary source of knee joint loading. One group of findings pertinent to clinical rehabilitation has been the evidence from the MOST cohort that quadriceps muscle weakness is a powerful risk factor for both development of symptomatic knee OA as well as worsening of joint space narrowing in women.[10, 11] It was not the mass of the muscle, but rather the amount of strength per unit area of the muscle (muscle quality) that was associated with risk for knee OA incidence and worsening,[12] suggesting that neuromuscular activation may be responsible. Another discovery regarding the role of the muscle-tendon functional unit was thatimpaired joint position sense was found to be associated with longitudinal risk for incident knee pain.[13]

To quantify the effects of knee OA on physical activity levels and evaluate the relationship of lower limb biomechanics with OA risk, several novel measurements were introduced at the 60-month clinic visit. A biomechanical finding of interest cast doubt on the long-held assumption that nearly all patellofemoralOA is a consequence of excessive lateral loading. Data from MOST (in combination with two other large OA cohorts) indicated that cartilage damage in the medial patellofemoralcompartment was at least as prevalent in older adults as cartilage damage in the lateral patellofemoralcompartment. Investigations are underway to better clarify the mechanisms for the development of medial patellofemoralOA and to develop strategies to prevent and treat OA in this less frequently studied joint.

For older adults, the benefits of physical activity are well known and include improved bone and joint health, reductions in pain and depressive symptoms, improvement in physical function, and prevention of disability. In order to attain these benefits, the Department of Health and Human Services (DHHS) recommends a minimum of 150 minutes/week of moderate intensity physical activity. Walking is by far the most common form of physical activity forolder adults. Therefore, to monitor weekly walking activity, an accelerometer-basedactivity monitor was issued for 7 days to all consenting participants at the 60- and 84-month MOST visits. These data demonstrated that only a small minority (< 10%) of participants with knee OA were walking with sufficient regularity and intensity to satisfy DHHS recommendations. This startling finding invigorated efforts to identify modifiable determinants of physical activity in this population. Findings to date have highlighted the importance of both intrinsic psychological factors, such as a positive affect,[14] and extrinsic

characteristics of the built environment[15] in facilitating older adults with knee OA to maintain healthful physical activity levels and avoid mobility-related disability.

The manner in which a person walks, and the dynamics of the lower limb during walking, can have important implications for load distribution at the knee, and perhaps for subsequent risk of knee OA onset and progression. Several gait alterations have been identified in patients with knee OA, and determining their association with disease risk is a primary objective of MOST. Although a fully instrumented gait lab is necessary to conduct biomechanical assessments using inverse dynamics, such assessments are not feasible in the context of an epidemiological study with thousands of participants and numerous other measurements. Therefore, in place of a gait lab, MOST pioneered the large-scale use of portable technologies, including the GAITRite instrumented walkway and the Emed-X digital pedobarograph, in order to obtain reliable measurements of many relevant kinematic and kinetic gait parameters. Numerous other measurements of gait have also been collected and will likely contribute to a better understanding of how the biomechanics of posture and movement strategies may be associated with risk for disease.

Strengths and Weaknesses of Using MOST Data for Rehabilitation Research

MOST has significant strengths relevant to rehabilitation research. As one of the largest and most comprehensive epidemiological studies with musculoskeletal measures in older adults, MOST provides a unique opportunity to identify modifiable risk factors that may be targets for future rehabilitation interventions. This includes reliable, longitudinal self-report and objective measures of potential risk factors for OA-associated symptoms, functional limitations, impairments, disability and quality of life. Enrollment of 3026 subjects and excellent retention rates (Table 3) provides sufficient statistical power for in-depth investigations, controlling for multiple variables, as well as subgroup analyses. In addition, MOST is conducted in two different regions of the United States, enhancing generalizability of study findings. New measurements or improved methods of collecting measurements have been added to MOST since initiation. While these changes have improved the volume and quality of available data, not all measurements were collected from baseline.

The focus on symptomatic disease enhances relevance to adults who present for clinical care. This focus contrasts with prior epidemiologic studies, which focused principally on radiographic OA. In addition, the approach to recruitment enhanced the value of the data collected. Prior epidemiological studies of OA have drawn from population samples, including both those at low risk and those at high risk of disease. The MOST cohort was enriched with participants at elevated risk for or with pre-existing knee OA. This provides the opportunity to evaluate factors affecting the course of disease and evaluate those who would be the best targets for preventive interventions. In prior studies, the small number of cases of OA developing or progressing over time has limited power to address the relationships of putative risk factors with disease. In contrast, rates of knee OA development and progression in the MOST cohort have exceeded expectations, providing even greater statistical power to address the study aims. In addition to the clinically relevant focus, in order to evaluate the effects of risk factors on structural outcomes, the MOST study also evaluates radiographic outcomes. Inclusion of both radiographic and symptomatic knee OA as outcomes permits comparison of risk factors for each of these as well as allowing assessment of how risk for incident and worsening disease may differ.

In using this rich source of data for rehabilitation research, it is important to understand limitations of the measurements in addition to the strengths. At baseline, knees were fully characterized with respect to height, flexion contracture, laxity and joint position sense. However, these tests have not been repeated at other time points. Several new measurements were added to the 60-month evaluation including gait assessment, accelerometry, pain

sensation, peripheral neuropathy, vibration perception threshold, muscle co-activation during isokinetic strength testing. Gait characteristics including the base of support, step length, the toe in or toe out orientation of the foot on the ground, step duration, and the proportion time spent with the limb in stance vs. swing during normal and fast-paced walking were assessed using a GAITRite device. The GAITRite device accurately records each foot contact distribution dynamically. However, this does not provide the full array of 3-dimensional kinetic and kinematic data for each body segment that could be acquired with a multi-camera motion analysis laboratory.

In addition, while collecting highly reliable measurements of strength on a large number of older adults, the concentric isokinetic strength measurements of the knee extensor and knee flexor muscles may not be representative of how these muscle groups are used during functional activities. In addition, muscle co-activation of the antagonist group could potentially reduce the net torque measured in the agonist group. To evaluate this possibility, muscle co-activation was measured during isokinetic strength testing using surface electromyography. These data for the medial and lateral quadriceps and hamstrings may clarify the how activation patterns relate to isokinetic strength as well as to clinical outcomes at follow-up.

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Table 1
Descriptive Characteristics of the MOST Cohort at Baseline

Characteristic	Value	All
Number of Participants		3026
Age at Baseline	Mean (SD)	62.5 (8.1)
Age (decade)	50-59	1167 (39%)
	60-69	1174 (39%)
	70-79	685 (23%)
Sex	Male	1820 (60%)
	Female	1206 (40%)
BMI (at BL)	Mean (SD)	30.7 (6.0)
BMI (categorical)	Under 25	448 (15%)
	25 to under 30	1092 (36%)
	30 or more	1485 (49%)
Race (self-reported)	White or Caucasian	2519 (83%)
	Black or African American	464 (15%)
	Other	43 (1%)
Clinic site	UAB	1519 (50%)
	UI	1507 (50%)
Smoking	Never a smoker	1674 (55%)
	Current smoker	197 (7%)
	Former smoker	1155 (38%)
Hand OA at Baseline	Frequency reported	2377 (79%)
Family history of knee OA	Frequency reported	1365 (45%)
Knee injury history	Frequency reported	1270 (42%)
Knee surgery history	Frequency reported	671 (22%)
PASE score	Mean (SD)	174.6 (88.4)
Charlson comorbidity score	Mean (SD)	0.53 (0.96)

Table 2
Publicly Released MOST Study Data by Time Point

Time points	Baseline	15 months	30 months	60 months
	4/2003 – 4/2005	2/2005– 5/2006	1/2006– 11/2007	4/2009– 12/2010
Demographics and Anthropometrics				
Age at baseline and sex	X			
Ethnicity, racial background, level of education, tobacco use	X			
Marital status and live alone or with others	X			X
Height and weight at age 25 and heaviest weight (self-report)	X			
Height, measured at visit	X			
Household status: Ability to pay bills, current				X
Weight and blood pressure, measured at visit	X	X (subset)	X	X
Osteoarthritis Risk Factors and Health Behaviors				
Employment and volunteer work hours: current and past year	X		X	X
Work history	X			
Fracture history and injuries (hip and spine), after age 40 and since last contact	X		X	X
Hip symptoms and surgery, ever and since last contact	X	X	X	X
Knee injury and surgery history, ever and since last contact	X	X		
Knee symptoms, past 12 months and past 30 days	X	X	X	X
Health History and Status				
Modified Charlson Comorbidity Questionnaire (Katz)	X		X	X
Joint Symptoms				
Back pain and function, past 30 days	X		X	X
Joint Pain (homunculus diagrams), past 30 days				
Body: shoulders, elbows, hips, wrists, hands, knees, ankles, feet, neck	X	X (subset)	X	X
Feet and hands	X			X
Knee buckling and activity limitation due to buckling, past 3 & 12 months	X		X	*
Knee pain visual analog scale (rating of degree of pain), past 30 days	X	X (subset)	X	X
Modified WOMAC and KOOS knee-related physical function, past 30 days	X	X (subset)	X	X
Modified WOMAC hip symptoms, past 30 days	X	X (subset)	X	
Hand exam for bony enlargements, measured at visit	X			
Functional Status and Disability				
Ability to walk without a walker, current			X	X
Assistive mobility devices and technology used, current				X
Limitation of activity due to pain, past 30 days	X	X	X	X
Modified Late-Life Disability Instrument, current	X	X (subset)	X	X
Physical Activity Scale for the Elderly (PASE), physical activities, past 7 days	X			*

Time points	Baseline	15 months	30 months	60 months
	4/2003 – 4/2005	2/2005– 5/2006	1/2006– 11/2007	4/2009– 12/2010
SF-12 (subject assessment of general health status), past 30 days	X	X (subset)	X	X
Stair flights climbed, past 7 days	X			
Mental Health and Cognitive Status				
CES-D long version (depression symptoms), past 7 days	X		X	X
Fillit cognitive screen, administered at visit				X
Medication Use and Supplements				
Medication inventory, past 30 days (after baseline visit, prescription only)	X	X (subset)	X	X
Salicylates/NSAIDs/opioids, current use			X	X
Bisphosphonates/estrogens, past 12 mo.				X
Knee injections/steroids, past 6 mo.	X		X	X
Physical Performance and Neuromuscular Measures				
20-meter walk and chair stands, timed	X		X	X
Isokinetic concentric knee extensor/flexor strength	X			X
Imaging				
1.0T Knee MRI, Knee x-ray (PA and lateral views; full-limb view at BL)	X	X (subset)	X	X

* not released

Table 3

Retention rates of MOST participants

	All	White	Non-White
15-month contact	99.6%	99.7%	99.0%
30-month contact	99.0%	99.3%	97.6%
30-month clinic visit	90.5%	91.8%	84.2%
60-month contact	94.3%	95.2%	89.6%
60-month clinic visit	79.4%	79.9%	76.4%
72-month contact	93.2%	93.8%	90.5%
84-month contact	91.5%	91.8%	89.7%
84-month clinic visit	74.4%	75.2%	70.3%

Note: known deceased not included in retention rate calculation for each time point